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Saskatchewan construction, upgrading & maintenance ... annual report
Date: 1990/91

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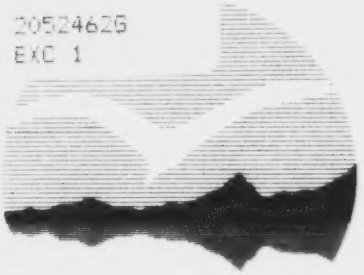

WATER
RESOURCES
BRANCH

SASKATCHEWAN DISTRICT

# CONSTRUCTION, UPGRADING AND MAINTENANCE

# 1990 - 91 ANNUAL REPORT

# CONSTRUCTION, UPGRADING AND MAINTENANCE

# 1990 - 91 ANNUAL REPORT

Water Resources Branch
Environment Canada
300 - 2365 Albert Street
Regina, Saskatchewan
S4P 4K1

J.H. Chubak
Construction Supervisor

December 20, 1991

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## 1.0 INTRODUCTION

The Saskatchewan District, Water Resources Branch has a continuing construction program to maintain its network of 334 hydrometric gauging stations. The program is carried out by in-house personnel except for specialized tasks, such as, earthwork, and supplying rocks, gravel and concrete, which are contracted out. Extensive use is made of prefabrication techniques and bulk purchases of construction supplies to r duce program costs and minimize field labour time.

Standard designs have been developed for such items as equipment shelters, stilling wells, metering bridges, cable cars and bench marks but items such as cableways and artificial controls are individually designed to meet specific site requirements. A description of construction practices, materials and equipment is contained in Appendix B.

Construction priorities are generally based on the following criteria;

1. Health and Safety
2. Physical integrity of the gauging station
3. Continuity of data collection
4. New construction
5. Data quality
6. General repairs or dismantling of stations

Projects are constructed and operated under cooperative arrangements with the Province of Saskatchewan and other agencies. The hydrometric cost-sharing agreement with the Province of Saskatchewan is described in the next section and cost responsibilities detailed.

This report also contains cost summaries, definitions, a history of expenditures from 1983-84 - 1990-91. A brief description and cost breakdown for projects completed in 1990-91, a description of construction practices, materials and equipment, photographs, and a location map are included in appendices.

For the purposes of this report, the projects are divided into three categories:

1. **CONSTRUCTION (C)**

   Installation of structures, equipment and instrumentation at a new gauging station.

2. **UPGRADING (U)**

   Installation of facilities at existing gauging stations to collect additional data, improve the quality of data or facilitate the collection of data.

3. **MAINTENANCE (M)**

   Repair and refurbishing of facilities at existing gauging stations or the removal of discontinued gauging stations and site restoration.

## 2.0 COST-SHARING ARRANGEMENTS

The cost-sharing arrangements between Canada and the Province of Saskatchewan are defined in the Memorandum of Agreement for Water Quantity Surveys signed by both governments on February 18, 1975. Under the Terms of Agreement, each gauging station is classified Federal, Federal-Provincial or Provincial by a Coordinating Committee. This classification is formalized annually through Schedule A to the Agreement and is the basis for sharing construction costs between the two governments.

Shareable construction costs are defined in the Memorandum of Agreement and Schedule B to the Agreement. In summary, direct costs such as salaries of construction personnel, field travel expenses, vehicle costs, construction materials, contract payments for services and depreciation of construction equipment are shareable. Stations classified as Federal are the cost responsibility of Canada, stations classified as Federal-Provincial are cost shared equally and stations classified as Provincial are the cost responsibility of the Province of Saskatchewan. The exceptions relate to equipment and instrumentation, whereby under Article VII of the Memorandum of Agreement, the operating agency is responsible for providing and paying the total cost of the basic water level recording equipment. Specialized equipment and/or instrumentation is paid for by the party or parties requiring the service.

Determination of the construction program is a joint consultative process with the Province of Saskatchewan and results in a program which is a blend of both federal and provincial government priorities. Priority changes during the year are also reviewed with the province and other government departments.

## 3.0 CONSTRUCTION PROGRAM 1990-91

This years construction program covered a vast area which focused mainly on maintenance. There were 70 projects (1 construction, 12 upgrading and 57 maintenance) completed in 1990-91. A few modifications were made to the construction program but only two with significant dollar value; Richardson Ditch near Consul (11AB058) and Cypress Lake East Outflow Canal (11AC060) were completely removed and later reinstalled to accommodate Agriculture Canada with channel dredging.

The work was carried out by the construction supervisor and a crew which consisted of a construction foreman, a construction assistant and a summer student with additional help from hydrometric personnel as required. Extensive use was made of prefabrication techniques and the assistant was employed during the winter period for this function.

The new construction was a temporary manometer station installed to monitor water levels at Rafferty reservoir. Being a temporary station salvageable material and instrumentation were omitted from the station cost.

The twelve upgrading projects completed this year ranged from construction of artificial controls to complete replacement of gauging stations.

Ten of the fifty-seven maintenance projects required extensive work which consisted of; repairing control, removing and reinstalling electrified gauging stations. General maintenance was carried out at the remaining stations to maintain safety, operational and environmental standards.

A prototype cable car brake system was installed at Qu'Appelle River below Craven Dam (05JK002). It was used during normal measurements, yet better tested by students from Saskatchewan Institute of Applied Science and Technology during a field trip. The technologist's report included the following:

- great to hold the cable car in place during measurements
- the brake shoe wore down to the metal after several free wheeling stops
- it has good potential and would like to try it at other sites.

Modifications will be made to the brake system and tested at two sites.

A three-wheeled crane was modified (Photo 4) to improve the ease and safety of taking discharge measurements at North Saskatchewan River near Deer Creek (05EF001). The wheels can be raised or lowered to accommodate the stepped curbed at the site and the boom was extended to provide additional reach over the rail. A vertical roller on the crane runs against the top rail to prevent the crane from tipping and a channel iron on the curb keeps the crane on track.

An insulated lower intake was installed at Pipestone Creek near Rose Valley (05LA004). There are now three within our network and they have reduced the frequency of steaming the intakes to about once per season. In cases where power is unavailable all lower intakes will be insulated in the future. The practice of bubbling nitrogen in the wells also appears to significantly reduce the incidence of ice cover forming in the well.

The cost of repairs due to vandals was about $500, while about $5000 was spent on vandal prevention methods. For example, a boathouse was constructed at Wathaman River below Wathaman Lake (06DC001) in an effort to reduce the frequency of thefts of the boat (Photo 1 and 2). The increased emphasis on vandal prevention over the past seven years has been worthwhile.

All projects identified for the 1990-91 Saskatchewan hydrometric construction program were subjected to a preliminary assessment to determine potential adverse environmental effects. Projects were subsequently screened as required by the federal Environmental Assessment and Review Process but none was judged to result in significant alteration to the natural environment.

The total cost of the 1990-91 construction program was $113 922.29. The provincial share of the cost was $28 458.32 and the federal share was $85 463.97.

A summary of the projects and their costs is given in Table 1 and a detailed costing of each project is contained in Appendix A. The breakdown of costs by station classification (construction, upgrading and maintenance) is illustrated in Figure 1. Figure 2 shows how the construction dollar was spent in 1990-91. Two-thirds of the construction expenditures is associated with wages and travel and one third is for material and services. Figure 3 shows the historical expenditures for construction from 1975-76, the year the cost-share agreement came into effect. The actual dollar expenditures have been consistent but there has been a significant decline in expenditures based on 1975 dollars.

Table 2 presents some approximate costs for gauging station installation and instrumentation.

## TABLE 1

## SUMMARY OF CONSTRUCTION COSTS
## 1990 – 1991

### FEDERAL – PROVINCIAL STATIONS

| Station Number | Station Name | Labour | Board and Accomm. | Travel | Material | Contract Services | Utilities | Total |
|---|---|---|---|---|---|---|---|---|
| UPGRADING | | | | | | | | |
| 05MC001 | Assiniboine River at Sturgis | 1618.64 | 682.63 | 435.00 | 2449.11 | 447.50 | – | 5632.88 |
| 05HH002 | Cromarty Creek near Birch Hills | 933.18 | 577.93 | 854.00 | 894.50 | 384.00 | – | 3643.61 |
| 05MA025 | Ranch Creek above Ranch Lake | 718.90 | 429.75 | 529.75 | 90.85 | 138.00 | – | 1907.25 |
| 06DC001 | Wathaman River below Wathaman Lake | 2255.31 | 1205.41 | 1482.00 | 1047.58 | 170.00 | – | 6160.30 |
| | SUBTOTAL UPGRADING | 5526.03 | 2895.72 | 3300.75 | 4482.04 | 1139.50 | – | 17344.04 |
| MAINTENANCE | | | | | | | | |
| 05FF001 | Battle River at Battleford | 374.80 | 166.13 | 206.00 | 9.00 | – | – | 755.93 |
| 05HA003 | Bear Creek near Piapot | 1414.70 | 756.17 | 375.00 | – | 87.00 | – | 2632.87 |
| 05EF005 | Big Gully Creek near Maidstone | 166.55 | 102.36 | 125.00 | 110.31 | – | – | 504.22 |
| 05EG006 | Birling Creek near Payton | 168.97 | 102.36 | 125.00 | 88.41 | – | – | 484.74 |
| 05KB005 | Burntout Brook near Arborfield | 465.34 | 265.32 | 305.00 | 206.59 | – | – | 1242.25 |
| 05EG004 | Crystal Creek near Iffley | 150.48 | 90.99 | 110.50 | 88.41 | – | – | 440.38 |
| 05KA009 | Goose Hunting Creek near Beatty | 405.35 | 103.94 | 51.00 | 80.75 | – | – | 641.04 |
| 05MA012 | Ironspring Creek near Watson | 149.89 | 69.77 | 39.00 | 8.55 | 78.00 | – | 345.21 |
| 05JK004 | Jumping Deer Creek near Lipton | 123.00 | – | 25.00 | – | – | – | 148.00 |
| 06CB001 | Lac La Ronge at La Ronge | 357.43 | 88.57 | 150.00 | 61.82 | – | – | 657.82 |
| 06AD007 | Makwa River at Rapid View | 907.62 | 418.68 | 500.00 | 181.69 | 830.00 | – | 2837.99 |
| 05JA003 | McDonald Creek near McCord | 449.74 | 248.89 | 193.25 | 265.59 | – | – | 1157.47 |
| 05GD002 | Oscar Creek near Krydor | 149.89 | 69.77 | 39.00 | 36.20 | – | – | 294.86 |
| 05LB005 | Red Deer River near Steen | 431.93 | 191.34 | 234.00 | 25.48 | 51.00 | – | 933.75 |
| 05LB006 | Shand Creek near Dillabough | 290.65 | 159.37 | 171.50 | 46.99 | – | – | 668.51 |
| 05HG001 | South Saskatchewan River at Saskatoon | 355.25 | 156.02 | 113.25 | 40.00 | 1000.00 | – | 1664.52 |
| 05MC002 | Stony Creek near Stenen | 335.53 | 139.67 | 100.00 | 105.36 | – | – | 680.56 |
| 05LE008 | Swan River near Norquay | 473.77 | 124.08 | 48.00 | 116.68 | – | – | 762.53 |
| 05JF012 | Wascana Creek below Kronau Marsh | 381.64 | 17.00 | 300.00 | – | 603.68 | – | 1302.32 |
| 06AF005 | Waterhen River near Goodsoil | 113.47 | 68.25 | 84.25 | 76.34 | – | – | 342.31 |
| 05MB001 | Yorkton Creek near Ebenezer | 1113.79 | 455.08 | 498.28 | 765.68 | 1058.00 | – | 3890.83 |
| | SUBTOTAL MAINTENANCE | 8779.79 | 3793.76 | 3793.03 | 2313.85 | 3707.68 | – | 22388.11 |
| TOTALS | | 14305.82 | 6689.48 | 7093.78 | 6795.89 | 4847.18 | – | 39732.15 |

Continued . . .

## TABLE 1 (continued)

## FEDERAL STATIONS

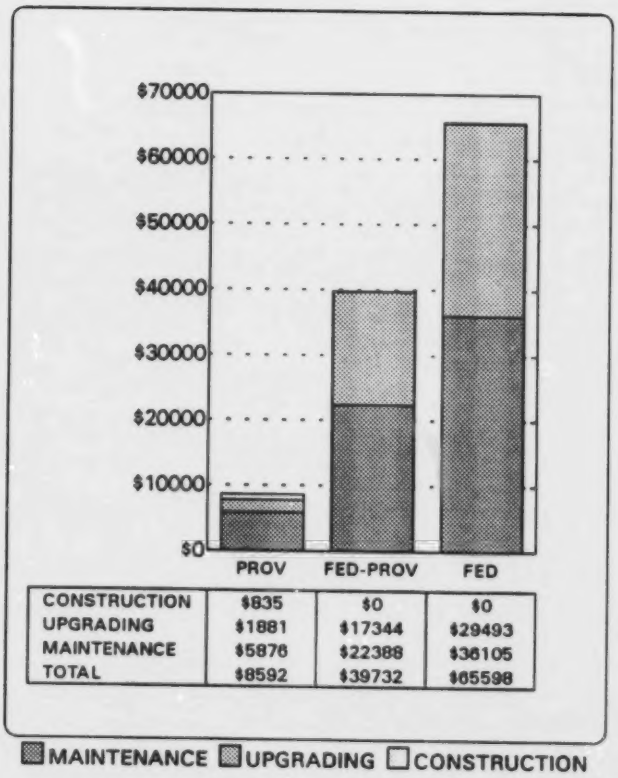
| Station Number | Station Name | Labour | Board and Accomm. | Travel | Material | Contract Services | Utilities | Total |
|---|---|---|---|---|---|---|---|---|
| UPGRADING | | | | | | | | |
| 05KC001 | Carrot River near Smoky Burn | 624.75 | 270.78 | 222.75 | 6.00 | 1851.00 | – | 2975.28 |
| 11AB085 | Cypress Lake West Inflow Canal Drain | 1048.69 | 559.21 | 335.20 | 183.15 | 27.50 | – | 2153.75 |
| 11AB108 | Middle Creek near Govenlock | 1641.83 | 836.43 | 607.75 | 507.50 | 692.50 | – | 4286.01 |
| 05JE006 | Moose Jaw River near Burdick | 641.26 | 25.50 | 70.00 | 157.30 | 1492.00 | – | 2386.06 |
| 05JM013 | Qu'Appelle River near Hyde | 2581.70 | 1005.32 | 594.00 | 4156.20 | 1466.50 | – | 9803.72 |
| 05KD003 | Saskatchewan River below Tobin Lake | 1855.01 | 743.07 | 933.50 | 2793.00 | – | – | 6324.58 |
| 05GG006 | Spruce River Diversion to Emma Lake | 700.43 | 294.55 | 468.50 | – | 100.00 | – | 1563.48 |
| | SUBTOTAL UPGRADING | 9093.67 | 3734.86 | 3231.70 | 7803.15 | 5629.50 | – | 29492.88 |
| MAINTENANCE | | | | | | | | |
| 05NC006 | Arcola Index Reservoir | 123.64 | 65.81 | 86.25 | 15.20 | – | – | 290.90 |
| 11AB118 | Battle Creek below Wilson's Weir | 147.80 | 87.57 | 40.00 | 114.88 | – | – | 390.25 |
| 06CD002 | Churchill River above Otter Rapids | 239.55 | 42.76 | – | 45.00 | – | – | 327.31 |
| 11AC060 | Cypress Lake East Outflow Canal | 1994.85 | 1034.70 | 1259.50 | 721.78 | 151.00 | – | 5161.83 |
| 05HA070 | Downie Lake Inflow Canal | 98.00 | 39.28 | 24.00 | – | 340.00 | – | 501.28 |
| 05KH011 | Dragline Channel near Squaw Rapids | 562.95 | 273.76 | 215.25 | 109.88 | – | – | 1161.84 |
| 11AC052 | Eastend Canal | 111.48 | 56.73 | 57.75 | 11.00 | – | – | 236.96 |
| 05JK005 | Echo Lake at Fish Hatchery | 102.30 | – | 25.00 | 114.34 | – | – | 241.64 |
| 05JM010 | Ekapo Creek near Marieval | 245.34 | 56.50 | 255.00 | 121.07 | – | – | 677.91 |
| 05JG006 | Elbow Diversion Canal at Drop Structure | 867.58 | 233.25 | 471.00 | 39.79 | 205.00 | – | 1816.62 |
| 05JF008 | Fahlman Creek near Davin | 810.85 | 46.75 | 107.50 | 146.84 | 24.00 | – | 1135.94 |
| 11AC041 | Frenchman River at International Bdry. | 287.78 | 159.00 | 62.50 | 142.64 | – | – | 651.92 |
| 05JL002 | Indianhead Creek near Indian Head | 335.53 | 25.50 | 150.00 | – | 75.00 | – | 586.03 |
| 05HA069 | Gap Creek below Downie Lake Diversior | 147.00 | 101.41 | 60.75 | – | 175.00 | – | 484.16 |
| 05NB001 | Long Creek near Estevan | 109.04 | 58.50 | 73.75 | 9.20 | – | – | 250.49 |
| 05NA003 | Long Creek at Western Crossing | 601.30 | 215.70 | 239.00 | 131.57 | 133.28 | – | 1320.85 |
| 05HA076 | Maple Creek below Junction Reservoir | 245.00 | 101.00 | 60.75 | – | 130.00 | – | 536.75 |
| 11AB001 | Middle Creek below Middle Creek Res. | 134.75 | 101.00 | 60.75 | – | 685.00 | – | 981.50 |
| 06CA001 | Montreal River at Outlet of Bigstone Lake | 188.45 | 88.57 | 150.00 | 90.85 | – | – | 517.87 |
| 05EF001 | North Saskatchewan River near Deer Cr. | 2277.80 | 578.42 | 622.50 | 664.52 | 1128.93 | – | 5272.17 |
| 05NE003 | Pipestone Creek above Moosomin Res. | 357.04 | 197.41 | 248.75 | – | 245.00 | – | 1048.20 |
| 05JE001 | Qu'Appelle River near Lumsden | 252.78 | 13.25 | 48.00 | 494.25 | – | – | 808.28 |
| 05JM001 | Qu'Appelle River near Welby | 335.50 | 186.12 | 48.00 | 80.20 | – | – | 649.82 |
| 11AB058 | Richardson Ditch near Consul | 1988.59 | 604.88 | 722.75 | 831.27 | 15.00 | – | 4162.49 |
| 05ND001 | Souris River near Glen Ewen | 81.78 | 43.87 | 56.25 | – | 212.50 | – | 394.40 |
| 05HD036 | Swift Current Creek below Rock Creek | 1434.21 | 729.32 | 519.75 | 213.00 | 862.00 | – | 3758.28 |
| 06DA001 | Wollaston Lake at Ross Channel | 1858.96 | 415.76 | 330.00 | 134.60 | – | – | 2739.32 |
| | SUBTOTAL MAINTENANCE | 15939.85 | 5556.82 | 5994.75 | 4231.88 | 4381.71 | – | 36105.01 |
| TOTALS | | 25033.52 | 9291.68 | 9226.45 | 12035.03 | 10011.21 | – | 65597.89 |

Continued . . .

TABLE 1 (continued)

## PROVINCIAL STATIONS

| Station Number | Station Name | Labour | Board and Accomm. | Travel | Material | Contract Services | Utilities | Total |
|---|---|---|---|---|---|---|---|---|
| UPGRADING | | | | | | | | |
| 05LA004 | Pipestone Creek near Rose Valley | 764.07 | 328.88 | 363.00 | 424.90 | – | – | 1880.85 |
| | SUBTOTAL UPGRADING | 764.07 | 328.88 | 363.00 | 424.90 | – | – | 1880.85 |
| CONSTRUCTION | | | | | | | | |
| 05NB032 | Rafferty Reservoir near Estevan | 351.44 | 54.84 | 317.50 | 111.39 | – | – | 835.17 |
| | SUBTOTAL CONSTRUCTION | 351.44 | 54.84 | 317.50 | 111.39 | – | – | 835.17 |
| MAINTENANCE | | | | | | | | |
| 05HF017 | Broderick Res. at West Embankment | 185.05 | 113.70 | 139.50 | 105.34 | – | – | 543.59 |
| 05KA001 | Carrot River near Kinistino | 405.35 | 103.94 | 51.00 | 80.75 | – | – | 641.04 |
| 05FF003 | Cutknife Creek near Cutknife | 449.58 | 192.03 | 164.00 | 140.55 | – | – | 946.16 |
| 06AD008 | Morin Creek near Meadow Lake | 311.47 | 124.42 | 173.75 | – | 125.00 | – | 734.64 |
| 05GB004 | Muddy Lake Inflow near Revenue | 149.89 | 69.77 | 39.00 | – | – | – | 258.66 |
| 05LA005 | Red Deer River near Archerwill | 563.80 | 235.16 | 270.25 | – | 212.00 | – | 1281.21 |
| 05MA016 | Romance Creek near Watson | 395.23 | 86.77 | 131.00 | 296.09 | – | – | 909.09 |
| 05JG001 | Sandy Creek near Caron | – | – | – | – | 60.00 | – | 60.00 |
| 05JC005 | Wood River Diversion to Chaplin Lake | 245.34 | 17.00 | 82.50 | 157.00 | – | – | 501.84 |
| | SUBTOTAL MAINTENANCE | 2705.71 | 942.79 | 1051.00 | 779.73 | 397.00 | – | 5876.23 |
| TOTALS | | 3821.22 | 1326.51 | 1731.50 | 1316.02 | 397.00 | – | 8592.25 |




| | PROV | FED-PROV | FED |
|---|---|---|---|
| CONSTRUCTION | $835 | $0 | $0 |
| UPGRADING | $1881 | $17344 | $29493 |
| MAINTENANCE | $5876 | $22388 | $36105 |
| TOTAL | $8592 | $39732 | $65598 |

Figure 1

1990-91 Costs
By Station
Classification

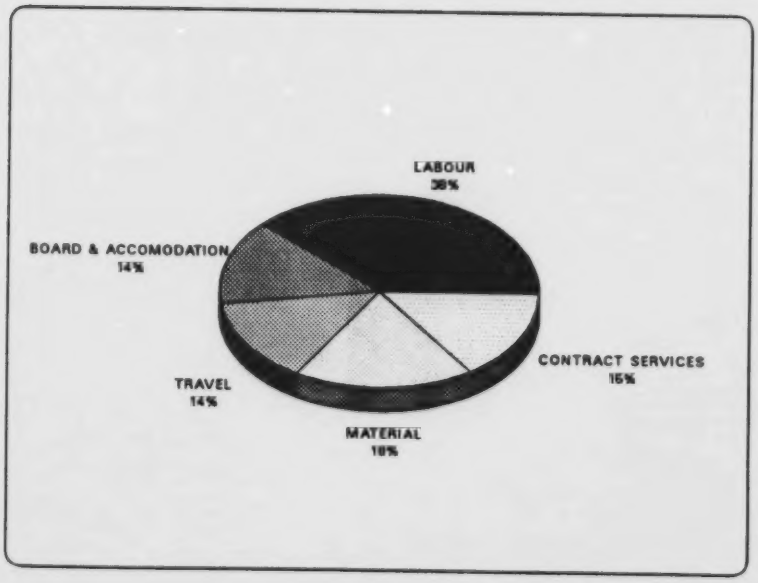



Figure 2

1990-91 Costs
By Activity

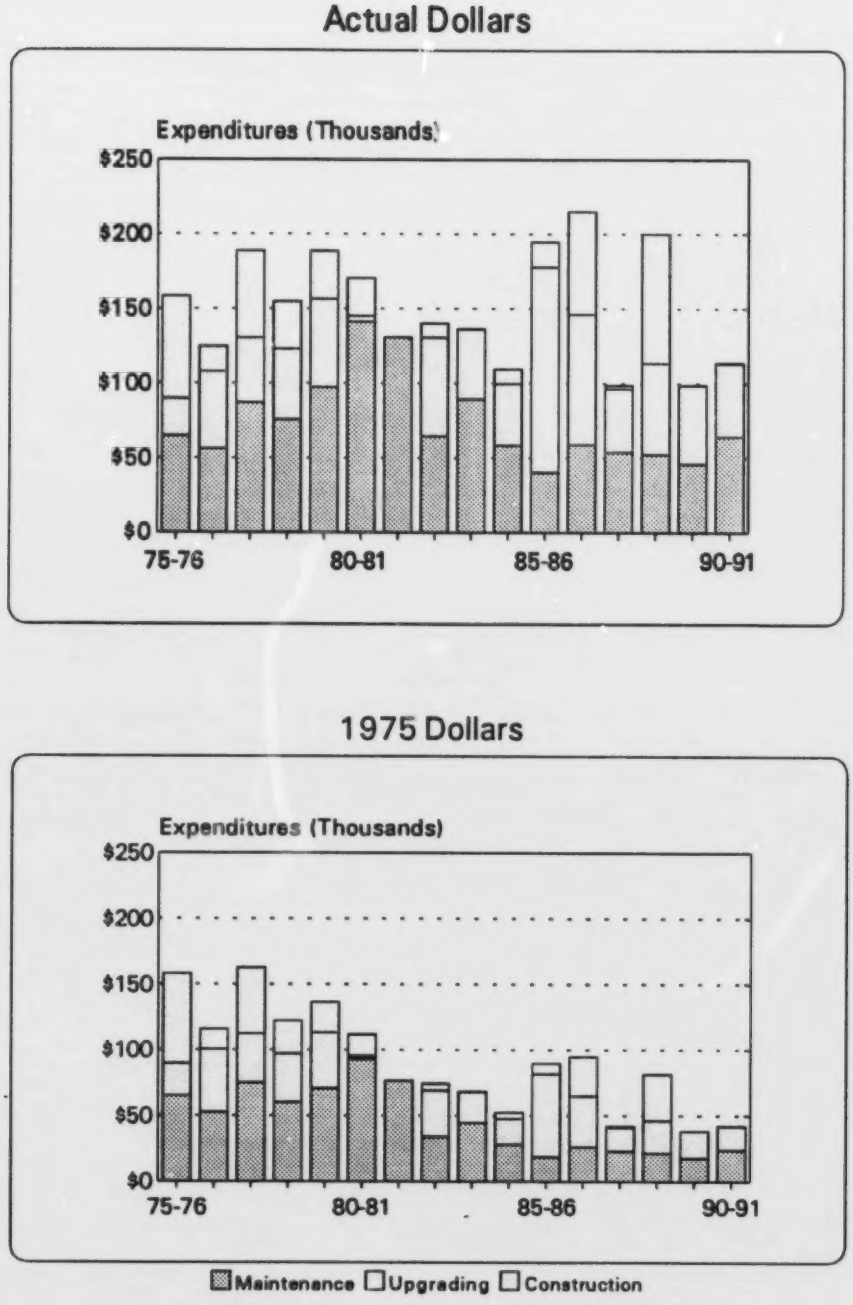



Figure 3 Historical Construction Costs

TABLE 2

APPROXIMATE CURRENT COSTS FOR ESTIMATING PURPOSES

| FABRICATED ITEMS | COST ($) |
|---|---|
| Included are the material and labour to fabricate the following: | |
| Standard 1500 mm diameter wood stave well (per metre of length) | 275.00 |
| Standard unwired shelter with well base | 2 050.00 |
| Standard unwired shelter with concrete base | 2 200.00 |
| Electrical wiring (per shelter) | 780.00 |
| Super insulated shelter | 2 450.00 |
| Cableway (2.5 m A-frames, cablecar, deadman) | 3 330.00 |
| Cableway 19 mm cable (per metre of length) | 7.00 |
| Sheet steel pile control (per lineal metre) | 400.00 |
| **INSTRUMENTATION** | |
| Servo-manometer, CAE Stacom | 5 035.00 |
| Recorder, A71 Stevens | 3 590.00 |
| Data Collection Platform (Bristol), antenna, terminal strip | 5 340.00 |
| Photovoltaic system | 417.00 |
| Memomark III & A-71 Mounts | 1 730.00 |
| Wire Weight Gauge | 350.00 |
| Electric Tape Gauge | 180.00 |
| Gauge plate (1 m section) | 10.00 |
| Batteries - Northern Region | 200.00 |
| - Southern Region | 100.00 |

# APPENDIX A

## DETAILED CONSTRUCTION COSTS

## CONSTRUCTION PROJECT INDEX


| STATION NAME | STATION NUMBER | PAGE |
|---|---|---|
| ARCOLA INDEX RESERVOIR | 05NC006 | 33 |
| ASSINIBOINE RIVER AT STURGIS | 05MC001 | 16 |
| BATTLE CREEK BELOW WILSON WEIR | 11AB118 | 33 |
| BATTLE RIVER AT BATTLEFORD | 05FF001 | 18 |
| BEAR CREEK NEAR PIAPOT | 05HA003 | 18 |
| BIG GULLY CREEK NEAR MAIDSTONE | 05EF005 | 19 |
| BIRLING CREEK NEAR PAYTON | 05EG006 | 19 |
| BRODERICK RESERVOIR AT WEST EMBANKMENT | 05HF017 | 49 |
| BURNTOUT BROOK NEAR ARBORFIELD | 05KB005 | 20 |
| CARROT RIVER NEAR KINISTINO | 05KA001 | 49 |
| CARROT RIVER NEAR SMOKY BURN | 05KC001 | 29 |
| CHURCHILL RIVER ABOVE OTTER RAPIDS | 06CD002 | 34 |
| CROMARTY CREEK NEAR BIRCH HILLS | 05HH002 | 16 |
| CUTKNIFE CREEK NEAR CUTKNIFE | 05FF003 | 50 |
| CYPRESS LAKE WEST INFLOW CANAL DRAIN | 11AB085 | 29 |
| CYPRESS LAKE EAST OUTFLOW CANAL | 11AC060 | 34 |
| CYRSTAL CREEK NEAR IFFLEY | 05EG004 | 20 |
| DOWNIE LAKE INFLOW CANAL | 05HA070 | 35 |
| DRAGLINE CHANNEL NEAR SQUAW RAPIDS | 05KH011 | 35 |
| EASTEND CANAL | 11AC052 | 36 |
| ECHO LAKE AT FISH HATCHERY | 05JK005 | 36 |
| EKAPO CREEK NEAR MARIEVAL | 05JM010 | 37 |
| ELBOW DIVERSION CANAL AT DROP STRUCTURE | 05JG006 | 37 |
| FAHLMAN CREEK NEAR DAVIN | 05JF008 | 38 |
| FRENCHMAN RIVER AT INTERNATIONAL BOUNDARY | 11AC041 | 38 |
| GAP CREEK BELOW DOWNIE LAKE DIVERSION | 05HA069 | 39 |
| GOOSEHUNTING CREEK NEAR BEATTY | 05KA009 | 21 |
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## A.0 DETAILED CONSTRUCTION COSTS

### A.1 DEFINITIONS FOR GAUGING STATIONS AND COST BREAKDOWN

The following definitions are used for individual stations.

| | |
|---|---|
| LABOUR | The cost includes salaries for the construction foreman, construction assistant and actual on-site time for the construction supervisor. Salaries of hydrometric staff are not included. |
| BOARD & ACCOMMODATION | Meals and living accommodation for personnel |
| TRAVEL | Road and air travel costs for labour, equipment and materials, or freight costs of materials and equipment to pick up point |
| MATERIALS | Components and supplies used in construction and maintenance of gauging stations (instruments excluded) |
| CONTRACT SERVICE | All services supplied by outside sources such as aircraft, earth moving, machinery rental, electrical wiring, trucking of gravel, rock and concrete, etc. |
| INSTRUMENTS | Servo-manometer, Type A recorder, Telemark and Code-A-Phone adaptor, Electrical Tape Gauge, staff gauge plates, special instrumentation and DCP. |
| UTILITIES | Construction of power, telephone lines and required connections to gauging station facilities |
| SALVAGE MATERIAL | Salvaged material is credited to the station |
| ELECTRICAL WIRING | The installation of 115 V, 30 A service entrance complete with steel mast, meter socket, two dual receptacles, one ceiling light complete with switch, and one utility box with pilot light switch for heat tape connection |
| HEAT TAPES | Pyrotenax copper and stainless steel Design A-type heating cable units are being used. The cold lead when incorporated, is common underground cable such as Canada Wire-F-NMW-10 Endurex 14/2 with ground. Heat tape and ground wire splices are soldered and covered with heat-shrink tubing. The stainless steel clad heat tapes will replace the copper clad heat tapes in the higher corrosive areas. |

## A.2 FEDERAL-PROVINCIAL (F-P) STATIONS

### A.2.1 Federal-Provincial Upgrading

U-1 Assiniboine River at Sturgis - 05MC001 - (F-P)

The well and intakes were lowered to ensure water connection. Replaced the old installation with a new well set on a shop fabricated concrete slab. Installed a 4.8 m wooden box intake and two 3NPS x 6.4 m intakes with flushing units; the lowest intake was equipped with a heat tape. Installed a new wired shelter. Salvaged the old shelter.

Construction Cost:

| | |
|---|---|
| Labour | 1 618.64 |
| Board & Accommodation | 682.63 |
| Travel | 435.00 |
| Material | 2 449.11 |
| Contract Services | 447.50 |
| Utilities | - |
| Total | 5 632.88 |

Station Cost:

| | |
|---|---|
| Federal Share | 2 816.44 |
| Provincial Share | 2 816.44 |
| Total | 5 632.88 |
| Project Completed | July 11, 1990 |

U-2 Cromarty Creek near Birch Hills - 05HH002 - (F-P)

Compacted clay and installed GEOWEB filled with crushed rocks to improve wading measurements. Geotextile was placed under the GEOWEB.

Construction Cost:

| | |
|---|---|
| Labour | 933.18 |
| Board & Accommodation | 577.93 |
| Travel | 854.00 |
| Material | 894.50 |
| Contract Services | 384.00 |
| Utilities | - |
| Total | 3 643.61 |

Station Cost:

| | |
|---|---|
| Federal Share | 1 821.81 |
| Provincial Share | 1 821.80 |
| Total | 3 643.61 |
| Project Completed | July 25, 1990 |

U-3 Ranch Creek above Ranch Lake - 05MA025 - (F-P)

Removed shelter and lowered well and intakes about 0.4 m. Reinstalled the shelter and instrumentation. Built a screened rock control. Installed a rod bench mark with brass cap and standard marker.

Construction Cost:

| | |
|---|---|
| Labour | 718.90 |
| Board & Accommodation | 429.75 |
| Travel | 529.75 |
| Material | 90.85 |
| Contract Services | 138.00 |
| Utilities | - |
| Total | 1 907.25 |

Station Cost:

| | |
|---|---|
| Federal Share | 953.63 |
| Provincial Share | 953.62 |
| Total | 1 907.25 |
| Project Completed | September 25, 1990 |

U-4 Wathaman River below Wathaman Lake - 06DC001 - (F-P)

Assembled a prefabricated metal boat house complete with treated wooden floor and boat rollers. Installed an adjustable tagline with aircraft warning markers. Materials and tools were transported by truck within 6 km of the site. An all-terrain vehicle, a boat, and manpower were used to transport materials the remaining 6 km.

The boat house was partially constructed of salvaged material and the tagline material was previously charged to construction.

Construction Cost:

| | |
|---|---|
| Labour | 2 255.31 |
| Board & Accommodation | 1 205.41 |
| Travel | 1 482.00 |
| Material | 1 047.58 |
| Contract Services | 170.00 |
| Utilities | - |
| Total | 6 160.30 |

Station Cost:

| | |
|---|---|
| Federal Share | 3 080.15 |
| Provincial Share | 3 080.15 |
| Total | 6 160.30 |
| Project Completed | June 11, 1990 |

A.2.2 Federal-Provincial Maintenance

M-1 Battle River at Battleford - 05FF001 - (F-P)

Repaired the metering bridge-frame safety restraining rail.

Construction Cost:

| | |
|---|---|
| Labour | 374.80 |
| Board & Accommodation | 166.13 |
| Travel | 206.00 |
| Material | 9.00 |
| Contract Services | - |
| Utilities | - |
| Total | 755.93 |

Station Cost:

| | |
|---|---|
| Federal Share | 377.97 |
| Provincial Share | 377.96 |
| Total | 755.93 |

Project Completed June 26, 1990

M-2 Bear Creek near Piapot - 05HA003 - (F-P)

Lowered the control by driving the sheet piling down. Removed the old concrete apron. Placed riprap downstream of the control and placed crushed rocks upstream of the control.

Construction Cost:

| | |
|---|---|
| Labour | 1 414.70 |
| Board & Accommodation | 756.17 |
| Travel | 375.00 |
| Material | - |
| Contract Services | 87.00 |
| Utilities | - |
| Total | 2 632.87 |

Station Cost:

| | |
|---|---|
| Federal Share | 1 316.44 |
| Provincial Share | 1 316.43 |
| Total | 2 632.87 |

Project Completed

M-3 Big Gully Creek near Maidstone - 05EF005 - (F-P)

Removed pipe bench mark and installed a rod bench mark with brass cap and standard marker.

Construction Cost:

| | |
|---|---|
| Labour | 166.55 |
| Board & Accommodation | 102.36 |
| Travel | 125.00 |
| Material | 110.31 |
| Contract Services | - |
| Utilities | - |
| Total | 504.22 |

Station Cost:

| | |
|---|---|
| Federal Share | 252.11 |
| Provincial Share | 252.11 |
| Total | 504.22 |
| Project Completed | June 29, 1990 |

M-4 Birling Creek near Payton - 05EG006 - (F-P)

Installed a screw bench mark with brass cap and standard marker.

Construction Cost:

| | |
|---|---|
| Labour | 168.97 |
| Board & Accommodation | 102.36 |
| Travel | 125.00 |
| Material | 88.41 |
| Contract Services | - |
| Utilities | - |
| Total | 484.74 |

Station Cost:

| | |
|---|---|
| Federal Share | 242.37 |
| Provincial Share | 242.37 |
| Total | 484.74 |
| Project Completed | June 29, 1990 |

M-5 Burntout Brook near Arborfield - 05KB005 - (F-P)

Replaced the heat tape with a 12.2 m Pyrotenax type and installed a screw bench mark with brass cap and standard marker.

Construction Cost:

| | |
|---|---|
| Labour | 465.34 |
| Board & Accommodation | 265.32 |
| Travel | 305.00 |
| Material | 206.59 |
| Contract Services | - |
| Utilities | - |
| Total | 1 242.25 |

Station Cost:

| | |
|---|---|
| Federal Share | 621.13 |
| Provincial Share | 621.12 |
| Total | 1 242.25 |
| Project Completed | September 21, 1990 |

M-6 Crystal Creek near Iffley - 05EG004 - (F-P)

Removed pipe bench mark and installed a screw bench mark with brass cap and standard marker.

Construction Cost:

| | |
|---|---|
| Labour | 150.48 |
| Board & Accommodation | 90.99 |
| Travel | 110.50 |
| Material | 88.41 |
| Contract Services | - |
| Utilities | - |
| Total | 440.38 |

Station Cost:

| | |
|---|---|
| Federal Share | 220.19 |
| Provincial Share | 220.19 |
| Total | 440.38 |
| Project Completed | June 25, 1990 |

M-7 Goosehunting Creek near Beatty - 05KA009 - (F-P)

Installed metal box to protect the electrical meter.

Construction Cost:

| | |
|---|---|
| Labour | 405.35 |
| Board & Accommodation | 103.94 |
| Travel | 51.00 |
| Material | 80.75 |
| Contract Services | - |
| Utilities | - |
| Total | 641.04 |

Station Cost:

| | |
|---|---|
| Federal Share | 320.52 |
| Provincial Share | 320.52 |
| Total | 641.04 |
| Project Completed | April 25, 1990 |

M-8 Ironspring Creek near Watson - 05MA012 - (F-P)

Crushed rock was hauled and spread at site; and the heat tape switch was replaced.

Construction Cost:

| | |
|---|---|
| Labour | 149.89 |
| Board & Accommodation | 69.77 |
| Travel | 39.00 |
| Material | 8.55 |
| Contract Services | 78.00 |
| Utilities | - |
| Total | 345.21 |

Station Cost:

| | |
|---|---|
| Federal Share | 172.61 |
| Provincial Share | 172.60 |
| Total | 345.21 |
| Project Completed | January 3, 1990 |

M-9 Jumping Deer Creek near Lipton - 05JK004 - (F-P)

The well was de-silted and the flushing pipe was shortened. Bench mark was also removed.

Construction Cost:

| | |
|---|---|
| Labour | 123.00 |
| Board & Accommodation | - |
| Travel | 25.00 |
| Material | - |
| Contract Services | - |
| Utilities | - |
| Total | 148.00 |

Station Cost:

| | |
|---|---|
| Federal Share | 74.00 |
| Provincial Share | 74.00 |
| Total | 148.00 |
| Project Completed | May 24, 1990 |

M-10 Lac La Ronge at La Ronge - 06CB001 - (F-P)

A rod bench mark and standard marker were installed.

Construction Cost:

| | |
|---|---|
| Labour | 357.43 |
| Board & Accommodation | 88.57 |
| Travel | 150.00 |
| Material | 61.82 |
| Contract Services | - |
| Utilities | - |
| Total | 657.82 |

Station Cost:

| | |
|---|---|
| Federal Share | 328.91 |
| Provincial Share | 328.91 |
| Total | 657.82 |
| Project Completed | June 15, 1990 |

M-11 Makwa River at Rapid View - 06AD007 - (F-P)

Rock filled eroded area around right bank of control and added riprap rocks to left bank of control. Lowered middle section of control and placed screened rocks to improve wading measurements. Installed two rod bench marks complete with brass caps and standard markers.

Construction Cost:

| | |
|---|---|
| Labour | 907.62 |
| Board & Accommodation | 418.68 |
| Travel | 500.00 |
| Material | 181.69 |
| Contract Services | 830.00 |
| Utilities | - |
| Total | 2 837.99 |

Station Cost:

| | |
|---|---|
| Federal Share | 1 418.99 |
| Provincial Share | - |
| Total | 1 418.99 |
| Project Completed | June 28, 1990 |

M-12 McDonald Creek near McCord - 05JA003 - (F-P)

Repaired upper intake, installed ladder and replaced heat tape with a Pyrotenax type.

Construction Cost:

| | |
|---|---|
| Labour | 449.74 |
| Board & Accommodation | 248.89 |
| Travel | 193.25 |
| Material | 265.59 |
| Contract Services | - |
| Utilities | - |
| Total | 1 157.47 |

Station Cost:

| | |
|---|---|
| Federal Share | 578.73 |
| Provincial Share | 578.74 |
| Total | 1 157.47 |
| Project Completed | May 31, 1990 |

M-13 Oscar Creek near Krydor - 05GD002 - (F-P)

Fitted a 3NPS ABS pipe into the deteriorated wooden intake.

Construction Cost:

| | |
|---|---|
| Labour | 149.89 |
| Board & Accommodation | 69.77 |
| Travel | 39.00 |
| Material | 36.20 |
| Contract Services | - |
| Utilities | - |
| Total | 294.86 |

Station Cost:

| | |
|---|---|
| Federal Share | 147.43 |
| Provincial Share | 147.43 |
| Total | 294.86 |
| Project Completed | March 20, 1990 |

M-14 Red Deer River near Steen - 05LB005 - (F-P)

Improved the wading section by adding screen rocks to it. Inserted a 3NPS ABS pipe into the deteriorating wooden box intake.

Construction Cost:

| | |
|---|---|
| Labour | 431.93 |
| Board & Accommodation | 191.34 |
| Travel | 234.00 |
| Material | 25.48 |
| Contract Services | 51.00 |
| Utilities | - |
| Total | 933.75 |

Station Cost:

| | |
|---|---|
| Federal Share | 466.88 |
| Provincial Share | 466.87 |
| Total | 933.75 |
| Project Completed | September 18, 1990 |

M-15 Shand Creek near Dillabough - 05LB006 - (F-P)

Located the buried upper wooden box intake and inserted a 3 NPS ABS pipe into it. Repaired wading section by adding screened rocks.

Construction Cost:

| | |
|---|---|
| Labour | 290.65 |
| Board & Accommodation | 159.37 |
| Travel | 171.50 |
| Material | 46.99 |
| Contract Services | - |
| Utilities | - |
| Total | 668.51 |

Station Cost:

| | |
|---|---|
| Federal Share | 334.26 |
| Provincial Share | 334.25 |
| Total | 668.51 |
| Project Completed | September 13, 1990 |

M-16 South Saskatchewan River at Saskatoon - 05HG001 - (F-P)

Filled settlement around the well. Repaired vandalised shelter. Meewasin Valley Authority planted shrubbery on landscaped area.

Construction Cost:

| | |
|---|---|
| Labour | 355.25 |
| Board & Accommodation | 156.02 |
| Travel | 113.25 |
| Material | 40.00 |
| Contract Services | 1 000.00 |
| Utilities | - |
| Total | 1 664.52 |

Station Cost:

| | |
|---|---|
| Federal Share | 832.26 |
| Provincial Share | 832.26 |
| Total | 1 664.52 |
| Project Completed | May 31, 1990 |

M-17 Stony Creek near Stenen - 05MC002 - (F-P)

Installed a rod bench mark with a brass cap and a standard marker.

Construction Cost:

| | |
|---|---|
| Labour | 335.53 |
| Board & Accommodation | 139.67 |
| Travel | 100.00 |
| Material | 105.36 |
| Contract Services | - |
| Utilities | - |
| Total | 680.56 |

Station Cost:

| | |
|---|---|
| Federal Share | 340.28 |
| Provincial Share | 340.28 |
| Total | 680.56 |
| Project Completed | July 13, 1990 |

M-18 Swan River near Norquay - 05LE008 - (F-P)

Installed shop fabricated bridge frame safety rail.

Construction Cost:

| | |
|---|---|
| Labour | 473.77 |
| Board & Accommodation | 124.08 |
| Travel | 48.00 |
| Material | 116.68 |
| Contract Services | - |
| Utilities | - |
| Total | 762.53 |

Station Cost:

| | |
|---|---|
| Federal Share | 381.27 |
| Provincial Share | 381.26 |
| Total | 762.53 |
| Project Completed | August 22, 1990 |

M-19 Wascana Creek below Kronau Marsh - 05JF012 - (F-P)

Installed a screened rock wading section.

Construction Cost:

| | |
|---|---|
| Labour | 381.64 |
| Board & Accommodation | 17.00 |
| Travel | 300.00 |
| Material | - |
| Contract Services | 603.68 |
| Utilities | - |
| Total | 1 302.32 |

Station Cost:

| | |
|---|---|
| Federal Share | 651.16 |
| Provincial Share | 651.16 |
| Total | 1 302.32 |
| Project Completed | August 30, 1990 |

M-20 Waterhen River near Goodsoil - 06AF005 - (F-P)

Installed a rod bench mark with brass cap and standard marker.

Construction Cost:

| | |
|---|---|
| Labour | 113.47 |
| Board & Accommodation | 68.25 |
| Travel | 84.25 |
| Material | 76.34 |
| Contract Services | - |
| Utilities | - |
| Total | 342.31 |

Station Cost:

| | |
|---|---|
| Federal Share | 171.16 |
| Provincial Share | 171.15 |
| Total | 342.31 |
| Project Completed | June 28, 1990 |

M-21 Yorkton Creek near Ebenezer - 05MB001 - (F-P)

Lowered the control 200 mm by removing two sections of GEOWEB along with the geotextile and clay base. Recompacted the clay base and installed two new sections of GEOWEB without the geotextile. Filled GEOWEB with crushed rocks and tamped it.

Construction Cost:

| | |
|---|---|
| Labour | 1 113.79 |
| Board & Accommodation | 455.08 |
| Travel | 498.28 |
| Material | 765.68 |
| Contract Services | 1 058.00 |
| Utilities | - |
| Total | 3 890.83 |

Station Cost:

| | |
|---|---|
| Federal Share | 1 945.41 |
| Provincial Share | 1 945.41 |
| Total | 3 890.83 |
| Project Completed | October 31, 1990 |

## A.3 FEDERAL STATIONS - (F)

### A.3.1 Federal Upgrading

U-5 Carrot River near Smoky Burn - 05KC001 - (F)

Cleared large rocks from the river reach and built a screened rock control. Replaced one cable car seat.

Construction Cost:

| | |
|---|---|
| Labour | 624.75 |
| Board & Accommodation | 270.78 |
| Travel | 222.75 |
| Material | 6.00 |
| Contract Services | 1 851.00 |
| Utilities | - |
| Total | 2 975.28 |

Station Cost:

| | |
|---|---|
| Federal Share | 2 975.28 |
| Provincial Share | - |
| Total | 2 975.28 |
| Project Completed | September 25, 1990 |

U-6 Cypress Lake West Inflow Canal Drain - 11AB085 - (F)

Hand poured a 150 mm x 1 800 mm x 9 144 mm steel reinforced concrete control and wading section. Replaced a broken bench mark marker.

Construction Cost:

| | |
|---|---|
| Labour | 1 048.69 |
| Board & Accommodation | 559.21 |
| Travel | 335.20 |
| Material | 183.15 |
| Contract Services | 27.50 |
| Utilities | - |
| Total | 2 153.25 |

Station Cost:

| | |
|---|---|
| Federal Share | 2 153.25 |
| Provincial Share | - |
| Total | 2 153.25 |
| Project Completed | May 15, 1990 |

U-7 Middle Creek near Govenlock - 11AB108 - (F)

Dug out rock control. Hauled, placed and tamped clay for base to install geotextile and GEOWEB. Filled GEOWEB with crushed rock and tamped.

Construction Cost:

| | |
|---|---|
| Labour | 1 641.83 |
| Board & Accommodation | 836.43 |
| Travel | 607.75 |
| Material | 507.50 |
| Contract Services | 692.50 |
| Utilities | - |
| Total | 4 286.01 |

Station Cost:

| | |
|---|---|
| Federal Share | 4 286.01 |
| Provincial Share | - |
| Total | 4 286.01 |
| Project Completed | May 10, 1990 |

U-8 Moose Jaw River near Burdick - 05JE006 - (F)

Lowered and reshaped control. Capped it with screened rocks to enable wading measurements. Rip rapped extensively downstream of control. Replaced the heat tape with a Pyrotenax type. (Photo 3)

Construction Cost:

| | |
|---|---|
| Labour | 641.26 |
| Board & Accommodation | 25.50 |
| Travel | 70.00 |
| Material | 157.30 |
| Contract Services | 1 492.00 |
| Utilities | - |
| Total | 2 425.56 |

Station Cost:

| | |
|---|---|
| Federal Share | 2 425.56 |
| Provincial Share | - |
| Total | 2 425.56 |
| Project Completed | December 4, 1990 |

U-9 Qu'Appelle River near Hyde - 05JM013 - (F)

Relocated the gauging station about 30.0 m downstream. (Photo 5 and 6)

Installed a 6.7 m deep standard well, a 3 NPS x 12.2 m lower pipe intake with a heat tape, a 3 NPS x 10.5 m pipe intake and a 9.0 m wooden box intake. The two pipe intakes were provided with flushing units. Installed a standard wired shelter. Landscaped the disturbed area. Supplied power service and installed a screw bench mark with brass cap and standard marker. Instrumentation was moved to the new location.

Construction Cost:

| | |
|---|---|
| Labour | 2 581.70 |
| Board & Accommodation | 1 005.32 |
| Travel | 594.00 |
| Material | 4 156.20 |
| Contract Services | 1 466.50 |
| Utilities | - |
| Total | 9 803.72 |

Station Cost:

| | |
|---|---|
| Federal Share | 9 803.72 |
| Provincial Share | - |
| Total | 9 803.72 |
| Project Completed | August 14, 1990 |

U-10 Saskatchewan River below Tobin Lake - 05KD003 - (F)

Replaced the deteriorating wooden shelter with a 1 525 mm x 2 000 mm wired metal shelter complete with extra shelving and shop fabricated concrete slab. Dismantled and hauled away the old shelter. Winched out the catamaran for winter storage. Reinstalled the instrumentation and reconnected the power service. Installed a new manometer line and anchor, which consisted of 93 m wire rope wrapped around 40 m flex conduit protected manometer line.

Construction Cost:

| | |
|---|---|
| Labour | 1 855.01 |
| Board & Accommodation | 743.07 |
| Travel | 933.50 |
| Material | 2 793.00 |
| Contract Services | - |
| Utilities | - |
| Total | 6 324.58 |

Station Cost:

| | |
|---|---|
| Federal Share | 6 324.58 |
| Provincial Share | - |
| Total | 6 324.58 |
| Project Completed | September 7, 1990 |

U-11 Spruce River Diversion to Emma Lake - 05GG006 - (F)

Built a crushed rock wading section immediately upstream of the steel piling control.

Construction Cost:

| | |
|---|---|
| Labour | 700.43 |
| Board & Accommodation | 294.55 |
| Travel | 468.50 |
| Material | - |
| Contract Services | 100.00 |
| Utilities | - |
| Total | 1 563.48 |

Station Cost:

| | |
|---|---|
| Federal Share | 1 563.48 |
| Provincial Share | - |
| Total | 1 563.48 |
| Project Completed | July 26, 1990 |

A.3.2. Federal Maintenance

M-22 Arcola Index Reservoir - 05NC006 - (F)

Replaced the valve handle brackets with stainless steel ones.

Construction Cost:

| | |
|---|---|
| Labour | 123.64 |
| Board & Accommodation | 65.81 |
| Travel | 86.25 |
| Material | 15.20 |
| Contract Services | - |
| Utilities | - |
| Total | 290.90 |

Station Cost:

| | |
|---|---|
| Federal Share | 290.90 |
| Provincial Share | - |
| Total | 290.90 |
| Project Completed | October 17, 1990 |

M-23 Battle Creek below Wilson Weir - 11AB118 - (F)

Replaced the heat tape with a 12.2 m Pyrotenax type.

Construction Cost:

| | |
|---|---|
| Labour | 147.80 |
| Board & Accommodation | 87.57 |
| Travel | 40.00 |
| Material | 114.88 |
| Contract Services | - |
| Utilities | - |
| Total | 390.25 |

Station Cost:

| | |
|---|---|
| Federal Share | 390.25 |
| Provincial Share | - |
| Total | 390.25 |
| Project Completed | June 16, 1990 |

M-24 Churchill River above Otter Rapids - 06CD002 - (F)

Installed a locking box.

Construction Cost:

| | |
|---|---|
| Labour | 239.55 |
| Board & Accommodation | 42.76 |
| Travel | - |
| Material | 45.00 |
| Contract Services | - |
| Utilities | - |
| Total | 327.31 |

Station Cost:

| | |
|---|---|
| Federal Share | 327.31 |
| Provincial Share | - |
| Total | 327.31 |
| Project Completed | October 6, 1990 |

M-25 Cypress Lake East Outflow Canal - 11AC060 - (F)

Removed gauge to accommodate Agriculture Canada with canal dredging. Reinstalled the well on a shop fabricated concrete slab, reinstalled the shelter, cattle fence and instruments. Installed a new 4.8 m wooden box upper intake and a 3 NPS x 6.4 lower intake complete with flushing unit and a 12.2 m Pyrotenax heat tape.

Construction Cost:

| | |
|---|---|
| Labour | 1 994.85 |
| Board & Accommodation | 1 034.70 |
| Travel | 1 259.50 |
| Material | 721.78 |
| Contract Services | 151.00 |
| Utilities | - |
| Total | 5 161.83 |

Station Cost:

| | |
|---|---|
| Federal Share | 5 161.83 |
| Provincial Share | - |
| Total | 5 161.83 |
| Project Completed | November 13, 1990 |

M-26 Downie Lake Inflow Canal - 05HA070 - (F)

Added screened rocks to the control and changed the overhead power service to underground service.

Construction Cost:

| | |
|---|---|
| Labour | 98.00 |
| Board & Accommodation | 39.28 |
| Travel | 24.00 |
| Material | - |
| Contract Services | 340.00 |
| Utilities | - |
| Total | 501.28 |

Station Cost:

| | |
|---|---|
| Federal Share | 501.00 |
| Provincial Share | - |
| Total | 501.00 |
| Project Completed | May 16, 1990 |

M-27 Dragline Channel near Squaw Rapids - 05KH011 - (F)

Uncovered and unplugged intake. Replaced heat tape with 12.2 m Pyrotenax one. Fabricated and installed a short metal sleeve in the wooden box intake. Desilted the well and replaced the cablecar seat.

Construction Cost:

| | |
|---|---|
| Labour | 562.95 |
| Board & Accommodation | 273.76 |
| Travel | 215.25 |
| Material | 109.88 |
| Contract Services | - |
| Utilities | - |
| Total | 1 161.84 |

Station Cost:

| | |
|---|---|
| Federal Share | 1 161.84 |
| Provincial Share | - |
| Total | 1 161.84 |
| Project Completed | August 8, 1990 |

M-28 Eastend Canal - 11AC052 - (F)

Repaired the flushing unit and cattle fence.

Construction Cost:

| | |
|---|---|
| Labour | 111.48 |
| Board & Accommodation | 56.73 |
| Travel | 57.75 |
| Material | 11.00 |
| Contract Services | - |
| Utilities | - |
| Total | 236.96 |

Station Cost:

| | |
|---|---|
| Federal Share | 236.96 |
| Provincial Share | - |
| Total | 236.96 |
| Project Completed | October 23, 1990 |

M-29 Echo Lake at Fish Hatchery - 05JK005 - (F)

Installed a rod bench mark with brass cap and standard marker.

Construction Cost:

| | |
|---|---|
| Labour | 102.30 |
| Board & Accommodation | - |
| Travel | 25.00 |
| Material | 114.34 |
| Contract Services | - |
| Utilities | - |
| Total | 241.64 |

Station Cost:

| | |
|---|---|
| Federal Share | 241.64 |
| Provincial Share | - |
| Total | 241.64 |
| Project Completed | May 22, 1990 |

M-30 Ekapo Creek near Marieval - 05JM010 - (F)

Desilted well and wooden box intakes. Installed provisional wired heat tape in the lower wooden intake. Repaired flushing unit.

Construction Cost:

| | |
|---|---|
| Labour | 245.34 |
| Board & Accommodation | 56.50 |
| Travel | 255.00 |
| Material | 121.07 |
| Contract Services | - |
| Utilities | - |
| Total | 677.91 |

Station Cost:

| | |
|---|---|
| Federal Share | 677.91 |
| Provincial Share | - |
| Total | 677.91 |
| Project Completed | August 28, 1990 |

M-31 Elbow Diversion Canal at Drop Structure - 05JG006 - (F)

Filled erosion around the well and riprapped area extensively. Installed a new wooden box intake with a shut-off inside the well. Desilted the well.

Construction Cost:

| | |
|---|---|
| Labour | 867.58 |
| Board & Accommodation | 233.25 |
| Travel | 471.00 |
| Material | 39.79 |
| Contract Services | 205.00 |
| Utilities | - |
| Total | 1 816.62 |

Station Cost:

| | |
|---|---|
| Federal Share | 1 816.62 |
| Provincial Share | - |
| Total | 1 816.62 |
| Project Completed | November 7, 1990 |

M-32 Fahlman Creek near Davin - 05JF008 - (F)

Poured steel reinforced concrete to raise the existing wading section 200 mm. Fabricated and installed a new V-notch.

Construction Cost:

| | |
|---|---|
| Labour | 810.85 |
| Board & Accommodation | 46.75 |
| Travel | 107.50 |
| Material | 146.84 |
| Contract Services | 24.00 |
| Utilities | - |
| Total | 1 135.94 |

Station Cost:

| | |
|---|---|
| Federal Share | 1 135.94 |
| Provincial Share | - |
| Total | 1 135.94 |
| Project Completed | July 31, 1990 |

M-33 Frenchman River at International Boundary - 11AC041 - (F)

Replaced heat tape with a Pyrotenax type and desilted well.

Construction Cost:

| | |
|---|---|
| Labour | 287.78 |
| Board & Accommodation | 159.00 |
| Travel | 62.50 |
| Material | 142.64 |
| Contract Services | - |
| Utilities | - |
| Total | 651.92 |

Station Cost:

| | |
|---|---|
| Federal Share | 651.92 |
| Provincial Share | - |
| Total | 651.92 |
| Project Completed | May 31, 1990 |

M-34 Indianhead Creek near Indian Head - 05JL002 - (F)

Repaired control and desilted intakes.

Construction Cost:

| | |
|---|---|
| Labour | 335.53 |
| Board & Accommodation | 25.50 |
| Travel | 150.00 |
| Material | - |
| Contract Services | 75.00 |
| Utilities | - |
| Total | 586.03 |

Station Cost:

| | |
|---|---|
| Federal Share | 586.03 |
| Provincial Share | - |
| Total | 586.03 |
| Project Completed | August 1, 1990 |

M-35 Gap Creek below Downie Lake Diversion - 05HA069 - (F)

Added crushed rocks to the control.

Construction Cost:

| | |
|---|---|
| Labour | 147.00 |
| Board & Accommodation | 101.41 |
| Travel | 60.75 |
| Material | - |
| Contract Services | 175.00 |
| Utilities | - |
| Total | 484.16 |

Station Cost:

| | |
|---|---|
| Federal Share | 484.16 |
| Provincial Share | - |
| Total | 484.16 |
| Project Completed | August 27, 1990 |

M-36 Long Creek near Estevan - 05NB001 - (F)

Repaired tool box.

Construction Cost:

| | |
|---|---|
| Labour | 109.04 |
| Board & Accommodation | 58.50 |
| Travel | 73.75 |
| Material | 9.20 |
| Contract Services | - |
| Utilities | - |
| Total | 250.49 |

Station Cost:

| | |
|---|---|
| Federal Share | 250.49 |
| Provincial Share | - |
| Total | 250.49 |
| Project Completed | October 16, 1990 |

M-37 Long Creek at Western Crossing of International Boundary - 05NA003 - (F)

The control and wading sections were improved by adding crushed rock. Also the heat tape was replaced with a Pyrotenax tape.

Construction Cost:

| | |
|---|---|
| Labour | 601.30 |
| Board & Accommodation | 215.70 |
| Travel | 239.00 |
| Material | 131.57 |
| Contract Services | 133.28 |
| Utilities | - |
| Total | 1 320.85 |

Station Cost:

| | |
|---|---|
| Federal Share | 1 320.85 |
| Provincial Share | - |
| Total | 1 320.85 |
| Project Completed | October 15, 1990 |

M-38 Maple Creek below Junction Reservoir - 05HA076 - (F)

Improved control by adding pit run gravel.

Construction Cost:

| | |
|---|---|
| Labour | 245.00 |
| Board & Accommodation | 101.00 |
| Travel | 60.75 |
| Material | - |
| Contract Services | 130.00 |
| Utilities | - |
| Total | 536.75 |

Station Cost:

| | |
|---|---|
| Federal Share | 536.75 |
| Provincial Share | - |
| Total | 536.75 |
| Project Completed | August 27, 1990 |

M-39 Middle Creek below Middle Creek Reservoir - 11AB001 -(F)

Added course pit run gravel to the wading section.

Construction Cost:

| | |
|---|---|
| Labour | 134.75 |
| Board & Accommodation | 101.00 |
| Travel | 60.75 |
| Material | - |
| Contract Services | 685.00 |
| Utilities | - |
| Total | 981.50 |

Station Cost:

| | |
|---|---|
| Federal Share | 981.50 |
| Provincial Share | - |
| Total | 981.50 |
| Project Completed | August 29, 1990 |

M-40 Montreal River at Outlet of Bigstone Lake - 06CA001 - (F)

Installed a rod bench mark with brass cap and marker.

Construction Cost:

| | |
|---|---|
| Labour | 188.45 |
| Board & Accommodation | 88.57 |
| Travel | 150.00 |
| Material | 90.85 |
| Contract Services | - |
| Utilities | - |
| Total | 517.87 |

Station Cost:

| | |
|---|---|
| Federal Share | 517.87 |
| Provincial Share | - |
| Total | 517.87 |
| Project Completed | June 15, 1990 |

M-41 North Saskatchewan River near Deer Creek - 05EF001 - (F)

A three wheeled crane was modified to improve the ease and safety of taking discharge measurements. The boom was extended, two wheels were lowered to accommodate the bridge curb. A vertical roller was added to allow the crane to run against top bridge rail. Counter weights can be added where bridge rail is unsuitable. Installed channel iron on the curb to keep the crane on track.

Construction Cost:

| | |
|---|---|
| Labour | 2 277.80 |
| Board & Accommodation | 578.42 |
| Travel | 622.50 |
| Material | 664.52 |
| Contract Services | 1 128.93 |
| Utilities | - |
| Total | 5 272.17 |

Station Cost:

| | |
|---|---|
| Federal Share | 5 272.17 |
| Provincial Share | - |
| Total | 5 272.17 |
| Project Completed | March 28, 1991 |

M-42 Pipestone Creek above Moosomin Reservoir - 05NE003 - (F)

Rock filled eroded right bank at control and increased riprap on the left bank. Placed screened rocks in middle section of control.

Construction Cost:

| | |
|---|---|
| Labour | 357.04 |
| Board & Accommodation | 197.41 |
| Travel | 248.75 |
| Material | - |
| Contract Services | 245.00 |
| Utilities | - |
| Total | 1 048.20 |

Station Cost:

| | |
|---|---|
| Federal Share | 1 048.20 |
| Provincial Share | - |
| Total | 1 048.20 |
| Project Completed | October 17, 1990 |

M-43 Qu'Appelle River near Lumsden - 05JE001 - (F)

Assisted in installation of two Waterlog Pressure Transducers. Repaired flushing system and shelter door.

Construction Cost:

| | |
|---|---|
| Labour | 252.78 |
| Board & Accommodation | 13.25 |
| Travel | 48.00 |
| Material | 494.25 |
| Contract Services | - |
| Utilities | - |
| Total | 808.28 |

Station Cost:

| | |
|---|---|
| Federal Share | 808.28 |
| Provincial Share | - |
| Total | 808.28 |
| Project Completed | January 8, 1991 |

M-44 Qu'Appelle River near Welby - 05JM001 - (F)

Installed a screw bench mark with brass cap and standard marker.

Construction Cost:

| | |
|---|---|
| Labour | 335.50 |
| Board & Accommodation | 186.12 |
| Travel | 48.00 |
| Material | 80.20 |
| Contract Services | - |
| Utilities | - |
| Total | 649.82 |

Station Cost:

| | |
|---|---|
| Federal Share | 649.82 |
| Provincial Share | - |
| Total | 649.82 |
| Project Completed | August 23, 1990 |

M-45 Richardson Ditch near Consul - 11AB058 - (F)

Moved the gauge about 1.0 km downstream as requested by Agriculture Canada.

Removed the shelter, well, intakes, steel sheet piling weir and wooden metering bridge. Installed and extended the well to the total depth of 3.4 m. Installed 4.0 m upper wooden box intake and a 3 NPS x 518 m lower intake complete with flushing unit. Reinstalled the shelter and instrumentation. Built a crushed rock wading section and installed a rod bench mark with a standard marker. (used Agriculture Canada's equipment for excavation).

Construction Cost:

| | |
|---|---|
| Labour | 1 988.59 |
| Board & Accommodation | 604.88 |
| Travel | 722.75 |
| Material | 831.27 |
| Contract Services | 15.00 |
| Utilities | - |
| Total | 4 162.49 |

Station Cost:

| | |
|---|---|
| Federal Share | 4 162.49 |
| Provincial Share | - |
| Total | 4 162.49 |
| Project Completed | October 22, 1990 |

M-46 Souris River near Glen Ewen - 05ND001 - (F)

Repaired control by adding crushed rocks.

Construction Cost:

| | |
|---|---|
| Labour | 81.78 |
| Board & Accommodation | 43.87 |
| Travel | 56.25 |
| Material | - |
| Contract Services | 212.50 |
| Utilities | - |
| Total | 394.40 |

Station Cost:

| | |
|---|---|
| Federal Share | 394.40 |
| Provincial Share | - |
| Total | 394.40 |
| Project Completed | October 16, 1990 |

M-47 Swift Current Creek below Rock Creek - 05HD036 - (F)

Anchored rock control by placing rock filled gabions on the downstream side. Placed screened rocks in the middle section to improve wading measurements.

Construction Cost:

| | |
|---|---|
| Labour | 1 434.21 |
| Board & Accommodation | 729.32 |
| Travel | 519.75 |
| Material | 213.00 |
| Contract Services | 862.00 |
| Utilities | - |
| Total | 3 758.28 |

Station Cost:

| | |
|---|---|
| Federal Share | 3 758.28 |
| Provincial Share | - |
| Total | 3 758.28 |
| Project Completed | May 30, 1990 |

M-48 Wollaston Lake at Ross Channel - 06DA001 - (F)

Removed the ant infested northern package and the partially rotten panelling. Increased the wall installation to R-20 value and the ceiling to R-40 value. Repanelled the shelter interior and built a new instrument shelf. Reinstalled instrumentation. The helicopter cost was incorporated into a scheduled hydrometric field trip.

Construction Cost:

| | |
|---|---|
| Labour | 1 858.96 |
| Board & Accommodation | 415.76 |
| Travel | 330.00 |
| Material | 134.60 |
| Contract Services | - |
| Utilities | - |
| Total | 2 739.32 |

Station Cost:

| | |
|---|---|
| Federal Share | 2 739.32 |
| Provincial Share | - |
| Total | 2 739.32 |
| Project Completed | October 3, 1990 |

## A.4 PROVINCIAL STATIONS

### A.4.1 Provincial Upgrading

U-12 Pipestone Creek near Rose Valley - 05LA004 - (P)

Replaced lower intake with a 3 NPS x 3.7 m ABS pipe connected to a 3 NPS x 3.0 m steel pipe then it was insulated with styrofoam which was protected with a wooden box culvert. The metal section of the intake was used in the well to accommodate the flushing unit.

Construction Cost:

| | |
|---|---|
| Labour | 764.07 |
| Board & Accommodation | 328.88 |
| Travel | 363.00 |
| Material | 424.90 |
| Contract Services | - |
| Utilities | - |
| Total | 1 880.85 |

Station Cost:

| | |
|---|---|
| Federal Share | - |
| Provincial Share | 1 880.85 |
| Total | 1 880.85 |
| Project Completed | November 1, 1990 |

A.4.2 Provincial Construction

C-1 Rafferty Reservoir - 05NB032 - (P)

Installed a manometer shelter with instrumentation. Installed a rod bench mark with brass cap and marker. (Temporary station therefore is no charge for shelter and instruments).

Construction Cost:

| | |
|---|---|
| Labour | 351.44 |
| Board & Accommodation | 54.84 |
| Travel | 317.50 |
| Material | 111.39 |
| Contract Services | - |
| Utilities | - |
| Total | 835.17 |

Station Cost:

| | |
|---|---|
| Federal Share | - |
| Provincial Share | 835.17 |
| Total | 835.17 |
| Project Completed | March 6, 1990 |

A.4.3 Provincial Maintenance

M-49 Broderick Reservoir at West Embankment - 05HF017 - (P)

Installed rod bench mark with brass cap and standard marker.

Construction Cost:

| | |
|---|---|
| Labour | 185.05 |
| Board & Accommodation | 113.70 |
| Travel | 139.50 |
| Material | 105.34 |
| Contract Services | - |
| Utilities | - |
| Total | 543.59 |

Station Cost:

| | |
|---|---|
| Federal Share | - |
| Provincial Share | 543.59 |
| Total | 543.59 |
| Project Completed | June 25, 1990 |

M-50 Carrot River near Kinistino - 05KA001 - (P)

Fabricated and installed a metal box over the electrical meter, to stop vandalism.

Construction Cost:

| | |
|---|---|
| Labour | 405.35 |
| Board & Accommodation | 103.94 |
| Travel | 51.00 |
| Material | 80.75 |
| Contract Services | - |
| Utilities | - |
| Total | 641.04 |

Station Cost:

| | |
|---|---|
| Federal Share | - |
| Provincial Share | 641.04 |
| Total | 641.04 |
| Project Completed | April 26, 1990 |

M-51 Cutknife Creek near Cutknife - 05FF003 - Provincial

Installed rod bench mark with brass cap and standard marker and installed a 3 NPS x 5.5 m ABS pipe into the deteriorating upper wooden intake.

Construction Cost:

| | |
|---|---|
| Labour | 449.58 |
| Board & Accommodation | 192.03 |
| Travel | 164.00 |
| Material | 140.55 |
| Contract Services | - |
| Utilities | - |
| Total | 946.16 |

Station Cost:

| | |
|---|---|
| Federal Share | - |
| Provincial Share | 946.16 |
| Total | 946.16 |

Project Completed June 26, 1990

M-52 Morin Creek near Meadow Lake - 06AD008 - (P)

Improved control by adding screened rock.

Construction Cost:

| | |
|---|---|
| Labour | 311.47 |
| Board & Accommodation | 124.42 |
| Travel | 173.75 |
| Material | - |
| Contract Services | 125.00 |
| Utilities | - |
| Total | 734.64 |

Station Cost:

| | |
|---|---|
| Federal Share | - |
| Provincial Share | 734.64 |
| Total | 734.64 |

Project Completed June 28, 1990

M-53 Muddy Lake Inflow near Revenue - 05GB004 - (P)

Restored power to the station.

Construction Cost:

| | |
|---|---|
| Labour | 149.89 |
| Board & Accommodation | 69.77 |
| Travel | 39.00 |
| Material | - |
| Contract Services | - |
| Utilities | - |
| Total | 258.66 |

Station Cost:

| | |
|---|---|
| Federal Share | - |
| Provincial Share | 258.66 |
| Total | 258.66 |
| Project Completed | March 8, 1990 |

M-54 Red Deer River near Archerwill - 05LA005 - (P)

Improved control by adding screened rock to wading section.

Construction Cost:

| | |
|---|---|
| Labour | 563.80 |
| Board & Accommodation | 235.16 |
| Travel | 270.25 |
| Material | - |
| Contract Services | 212.00 |
| Utilities | - |
| Total | 1 281.21 |

Station Cost:

| | |
|---|---|
| Federal Share | - |
| Provincial Share | 1 281.21 |
| Total | 1 281.21 |
| Project Completed | September 11, 1990 |

M-55 Romance Creek near Watson - 05MA016 - (P)

Replaced the heat tape twice during the 1990-91 season. The final replacement was a Pyrotenax stainless steel cover heat tape.

Construction Cost:

| | |
|---|---|
| Labour | 395.23 |
| Board & Accommodation | 86.77 |
| Travel | 131.00 |
| Material | 296.09 |
| Contract Services | - |
| Utilities | - |
| Total | 909.09 |

Station Cost:

| | |
|---|---|
| Federal Share | - |
| Provincial Share | 909.09 |
| Total | 909.09 |
| Project Completed | January 23, 1991 |

M-56 Sandy Creek near Caron - 05JG001 - (P)

Lowered the control. (work done by hydrometric personnel).

Construction Cost:

| | |
|---|---|
| Labour | - |
| Board & Accommodation | - |
| Travel | - |
| Material | - |
| Contract Services | 60.00 |
| Utilities | - |
| Total | 60.00 |

Station Cost:

| | |
|---|---|
| Federal Share | - |
| Provincial Share | 60.00 |
| Total | 60.00 |
| Project Completed | October 15, 1990 |

M-57 Wood River Diversion to Chaplin Lake - 05JC005 - (P)

Replaced the heat tape with a Pyrotenax stainless steel one.

Construction Cost:

| | |
|---|---|
| Labour | 245.34 |
| Board & Accommodation | 17.00 |
| Travel | 82.50 |
| Material | 157.00 |
| Contract Services | - |
| Utilities | - |
| Total | 501.84 |

Station Cost:

| | |
|---|---|
| Federal Share | - |
| Provincial Share | 501.84 |
| Total | 501.84 |
| Project Completed | February 11, 1991 |

# APPENDIX B

## Description of Construction Practices, Materials and Equipment

## B.0 DESCRIPTION OF CONSTRUCTION PRACTICES, MATERIALS AND EQUIPMENT

### B.1 SAFETY

Safety of structures is of the utmost importance and has the highest priority. However, there is no substitute for common sense. Numerous things are done to make the gauging sites a safer work place. Access aluminum ladders in stilling wells are mounted in such a manner as to allow 180 mm toe room. Instrument shelters are equipped with door holders and trap door holders. The electrical installation meets all provincial safety regulations. Safety inspection of cableways is completed each year and those found in poor or unsafe condition have been rebuilt in the continuing program of replacing the wood structures with steel. Heat tape switches are replaced with pilot light switches, and electric tape gauges are used in stilling wells. The construction crew is supplied with the necessary safety equipment during construction and are trained in safe construction practices.

### B.2 INSTRUMENT SHELTERS

The standard instrument shelter is a 1600 mm x 1600 mm x 2500 mm walk-in galvanized pre-fabricated 24 gauge steel building. It is insulated and lined with 3 mm plywood panelling over a polyethylene vapour barrier and fitted with an appropriate instrument shelf. Shelters are shop assembled in Regina and wired for 115 V, 60 A electrical entrance service. In remote areas shelters are shop assembled and flown into site by helicopter.

For servo-manometer installations a standard instrument shelter is erected on a steel reinforced light aggregate concrete slab. In some remote northern installations where suitable granular material is not available, 100 mm x 100 mm lumber is used with a 20 mm plywood floor.

For installations over wood stave wells, the standard shelter is erected on a 76 mm x 76 mm x 5 mm angle-iron frame. The instrument shelter has a 19 mm plywood floor with an access trap door to the well that is held in the open position by a screen door holder.

The standard northern shelter is constructed in the Regina warehouse. The shelter has R24 insulation in the walls and floor, and R36 insulation in the roof. The shelter is equipped with a catadyne heater with 300 kJ/hr output which keeps it approximately 18°C above ambient temperature.

Prior to 1988, gauging stations in northern Saskatchewan were constructed with an interior instrument cabinet (Northern heat package) 1700 mm high and 800 mm wide (outside dimensions) and insulated with 15 mm styrolite. The cabinet is heated with a catadyne heater.

## B.3 STILLING WELLS

### B.3.1 General

All inbank installations of stilling wells are made with wood staves radially milled to internal and external circumference of the well diameter. Most well installations are 1500 mm inside diameter. Staves are interlocked by tongue and groove and the edges of the staves are in full bearing with each other. Commonly used softwood species are pine, western and eastern hemlock and Douglas fir. Any softwood which meets grading specifications and is suitable for pressure treatment may be used. All staves are pressure treated in accordance with CSA. 080 Specification Group, Pentachlorophenol. Standard staves for 1500 mm inside diameter wells are 70 mm thick with the most common length being 2400 mm. Access to the bottom of the well is by aluminum ladder, extending the full depth of the well, and installed in such a manner as to leave 180 mm toe clearance.

### B.3.2 Upper Intake System

The upper intake normally consists of a box culvert made of treated 50 mm x 150 mm wooden plank and placed approximately 300 mm above the normal winter ice level. A galvanized, 12 mm square, 16 gauge wire mesh screen is stapled to the stream end of the box culvert to prevent trash and small animals from entering the well. For deeper wells and where in-bank distances are long, a 3 NPS steel pipe is normally substituted for the box culvert.

### B.3.3 Lower Intake System

The lower intake consists of a 3 NPS black steel pipe placed near the stream bed. In streams where the velocity past the pipe may cause significant drawdown, the intake pipe is provided with a static tube. The lower intake is reduced to take a 2 NPS cross

fitting immediately inside the well. On the right-angle side of the cross fitting a 2 NPS standard shut-off valve is placed with the opposite side accommodating a standard flushing system. Where power is available, the in-line opening of the cross fitting may be used for installation of a heat tape, which is placed the full length of the pipe. The bottom of the intake is usually installed 300 mm to 600 mm above the bottom of the well cribbing to allow for silt deposition.

Where power is unavailable an insulated lower intake is used. The intake is placed into a treated wooden box culvert in a manner to allow at least 75 mm of foam insulation to surround the pipe.

B.3.4 Inside Gauge

Electric tape gauges are used in all well installations and is now considered the standard gauge. Well installations since 1988 are no longer equipped with gauge plates.

B.3.5 Well Floor

The standard well floor is 150 mm steel-reinforced concrete placed 600 mm below the lower intake pipe. If the bottom of the well excavation is wet and the material semi-fluid because of a high water table, a treated plank floor is placed in the bottom, held together by an angle iron on the periphery. Uprights, welded to the angle iron, are lagged to the staves with 10 mm x 64 mm lag bolts. Spacing between planks relieves hydraulic pressure.

## B.4 CABLEWAYS

### B.4.1 A-Frames

All cableway A-frames are built to standard plans, and fabricated from 4 NPS black iron pipe. A-frames with a height of 2400 mm or more, have a cable car loading platform with access steps. The standard steel loading platform consists of a 1370 mm x 1800 mm angle iron frame filled with an open non-skid surface steel planking. This unit is fastened and braced to the standard A-frame in an offset position to facilitate loading of the cable car. The angle iron is 51 mm x 51 mm x 5 mm. The steel planking is ARMCO type III having a width of 229 mm, depth 51 mm, interlocking legs, and made from 16 gauge galvanized steel. Access steps are fabricated from the same material. All units including the cable car are painted international orange and white to Transport Canada specifications. A-frame pedestals are normally constructed using concrete made from sulphate resistant cement with a maximum aggregate size of 25 mm. Sono tube of 610 mm diameter is normally used for forms extending 600 mm to 900 mm into the ground. Transit mix is used where available; if not, the concrete is mixed on site.

### B.4.2 Anchorage

The standard size of the deadman used in most soil types and for cable spans less than 100 m is 1200 mm x 1200 mm x 900 mm deep or larger as required and made from sulphate resistant cement and reinforced with steel bars. Cable anchorage for the main cable consists of one 25 mm diameter bar 3500 mm long bent into a triangular shape and embedded in the deadman. A 20 mm diameter, 1800 mm long bar bent into a triangular shape is used for anchorage of the A-frame tieback cable.

Rock anchors are used at locations where bedrock is exposed at the surface. Normally two rock anchors are installed with one acting as the cable anchorage and the second cabled to the first as a safety backup. The rock anchor normally used is CLM Industries Catalogue Number 9026TE rock guy bolt anchor with wedge. A 25 mm diameter hole is drilled in the bedrock at an angle of approximately 90° to the slope of the main cable and drilled to a depth of approximately 380 mm. The anchor is pounded into the hole which expands the bottom of the anchor and centres it in the hole. The remaining void is then filled with a polymeric M-bed superflow grout unless the temperature is below freezing then an epoxy U-grout is used.

B.4.3 Cable (Wire Rope)

For most main cables a 19 mm diameter cable is standard. A safety factor of 6:1 is used in design of cable size, sag and attachment. Table 4 denotes the use and specifications of cable used.

TABLE 3

STANDARD CABLES

| USE | Cableway-main Cable | Tie Backs & Aircraft Warning Markers | Arctic Permanent Tagline | Tagline |
|---|---|---|---|---|
| DIAMETER | 19.05 mm | 9.525 mm | 4.762 mm | 3.175 mm |
| CONSTRUCTION | 6 x 19 right lang lay improved plow steel | 6 x 19 right lang lay mild plow steel | Aircraft control cable 7x19 | Aircraft control cable 7x19 |
| CORE | Fibre | Fibre | Steel | Steel |
| BREAKING STRENGTH | 191 kN | 53 kN | 18.7 kN | 8.9 kN |
| MASS | 1.34 kg/m | 0.34 kg/m | | |
| REMARKS | Galvanized | Galvanized | Galvanized | Galvanized |

B.4.4 Turnbuckles

All turnbuckles are drop forged and galvanized. On long cableways (60 m or more) turnbuckles are placed on both ends of the cable to allow for more adjustment of sag tension.

(1) 32 mm x 610 mm jaw and eye with 610 mm takeup.
1064 mm overall length in closed position. Strength 235 kN.

(2) 19 mm x 457 mm jaw and eye with 457 mm takeup.

(3) 13 mm x 305 mm jaw and eye with 300 mm takeup.
500 mm overall length in closed position.

B.4.5 Crosby Clips

For 19 mm diameter cable four 19 mm clips are used with 460 mm minimum turnback from heavy duty thimble on the end of the cable to give maximum strength.

For 10 mm diameter cable, three U-type 10 mm clips are used with 180 mm minimum turnback from thimble on the cable to give maximum strength.

B.4.6 Thimbles

Thimbles used are regular pattern, extra heavy duty and galvanized. They are used for sharp cable bends and points of wear.

B.4.7 Aircraft Warning Markers

Standard extensions are designed for attachment to 4 NPS pipe A-frames. Angle iron supports are two 76mm x 76mm x 6mm x 3000mm angle iron. Spacers of 2 NPS x 300mm pipe are welded between the two angle irons to support aircraft warning marker cable.

The support is then bolted or welded to the back of the A-frame to give the desired height above the main cable depending on the

span, 10 mm or 6 mm cable is used to carry the marker cones. The cable is anchored to the deadmen and is provided with a turnbuckle for adjustment.

The marker cones for a cableway are 460 mm high with a base diameter of 460 mm and the cones for a tagline are 300 mm high and have a base diameter of 395 mm. Both cones are made of fibreglass and are international orange or white in color. The cones are purchased from various suppliers.

B.4.8 Cable Cars

The standard sit-down car with two seats and foot rest is 1800 mm x 600 mm constructed with treated 50 mm x 100 mm wood frame covered with treated 16 mm plywood. The top edge of the plywood is covered with a galvanized 24 gauge metal channel 20 mm wide x 13 mm to protect and keep moisture out. Two drain holes are drilled immediately above each seat to prevent moisture build-up and deterioration. Standard cable car hangers and footrest irons are made of 5 mm x 50 mm mild steel flat iron and are fastened to the cable car in such a manner that the sides of the seat are clear of obstructions. Sheaves are 200 mm diameter cast iron grooved for 19 mm cable and supplied with two SKF 1716204-012 sealed bearings. Movement is by hand cable puller. The unit is painted international orange and white to Transport Canada specifications.

The lightweight sit-down car with two seats is approximately 25 kg. The main structure is made of 25 mm square aluminum tubing; hangers and foot rest consists of 50 mm x 6 mm aluminum strap, hinged so as to fold into the car for transport or storage. the sheaves are 152 mm diameter aluminum alloy supplied with SKF 1716204-012 sealed bearing. Movement is by hand cable puller.

B.4.9 Cable Car Puller

The cable car puller normally used is adjustable to cable size, and is available in long and short handle sizes and is constructed from aluminum alloy according to standard Water Resources Branch plans.

B.4.10 Cable Car Lock and Holder

The cable car holder is constructed from 50 mm x 6 mm strap iron which is bolted or welded to the A-frame. The holder is positioned so that a 'U' shaped hook at the end of the holder will engage the cable car support arm. Car is secured when not in use by a 900 mm x 10 mm chain fastened to the A-frame and attached to cable car support arm and padlocked.

## B.5 METERING BRIDGE

A small lightweight metering bridge has been developed to replace very short span cableways of not more than 25 m in length. The cost is comparable to the construction of a cableway at the same site. The bridge is built of 25 mm x 25 mm tubing and is similar to a simple truss bridge of the Pratt design. The deck is composed of 4 or 5 widths of interlocking non-slip steel planking (Armco Inter-locking Grating). A pipe railing on both sides is for safety and measuring.

## B.6 ARTIFICIAL CONTROLS

Most artificial controls are designed on a 'one of a kind' basis giving consideration to flow range, stream bed material and banks, accuracy required and availability of construction materials. A number of types as described below have been utilized dependent on conditions.

### B.6.1 Steel Sheet Piling

There are a number of different weights (gauges) of steel sheet piling which may be utilized with the most common having a horizontal covering width of 500 mm. All are deformed and have interlocking edges. They are obtainable in such common lengths as 2400 mm, 3000 mm, 3600 mm etc. Armco M581 or equivalent is used in the Saskatchewan district. The channel shape determines piling requirements. Piling may be driven below the frost line in suitable stone-free soil, otherwise it is dug in. The portion above the stream bed is trimmed to any desired profile and is protected on the downstream side by rock rip-rap and the upstream side with crushed rock or screened rock formed into a wading apron. Steel sheet piling is also used with steel reinforced concrete heads having various shapes for different types of controls and wading sections. The piling forms a cut-off wall that is driven below the frost line for stability, and gives support to the concrete head.

### B.6.2 Concrete

Various designs and sizes of concrete controls have been constructed, examples being broad-crested weirs, Trenton type, Parshall flumes and small wading sections with cut-off walls. These structures are usually constructed of steel reinforced concrete. The steel reinforcing is commonly 10 mm or 13 mm deformed mild steel bar. The concrete normally specified is 27.6 MPa with a maximum 20 mm aggregate.

### B.6.3 Rock and Gravel

Extensive use has been made of crushed rock, screened rock and gravel to improve natural stream bed control characteristics and to provide a uniform section for wading measurements. The cost is significantly less than a rigid type of artificial control, and

provided the upstream and downstream slopes to the crest are kept to less than 10 to 1, the stability is relatively good.

B.6.4 GEOWEB

GEOWEB is an expandable honey-comb structure of high-density polyethylene which is used to strengthen unstable soils by employing the principle of confinement. The system was developed by the U.S. Corps of Engineers, in co-operation with Presto Products Incorporated, initially for miliary uses. More recently, GEOWEB has been used in a wide range of civilian construction works such as road construction on soft subgrades, retaining walls and many types of erosion and flood control projects.

The basic polymer is extremely inert, chemically, and is blended with carbon black to provide high resistance to ultra-violet radiation. The ultrasonically-welded seams which form the grid have a peel-strength of 136 kg. The standard expanded grid size is 2.44 m x 6.10 m, although special sizes are available to order.

The honey-comb cells are filled with crushed aggregate and packed with a plate tamper. The size of aggregate is governed by the stream velocity and the following table is used as a guide.

| Maximum Velocity (m/s) | Aggregate size (mm) |
|---|---|
| < 1.5 | 25 |
| 1.5 - 2.5 | 63 |
| 2.5 - 3.0 | 88 |

B.7 BENCH MARKS

There are three types of bench marks (BM) used in the Saskatchewan network - plug, rod and screw. Three BMs are normally placed at each hydrometric station.

At some stations where there is appropriate stability such as bedrock or concrete bridge abutment etc., a plug BM with standard WSC cap is drilled and grouted in.

The rod BM consists of a number of sections of 19 mm diameter rods approximately 1200 mm long. The first length, or starter rod, to be driven is a deformed re-bar having at one end a 50 mm taper and a blunt end of 6 mm. THe following rods are smooth mild steel cold roll. All rods are joined by using the standard friction fit electrical ground rod coupler which tightens as the rods are driven. An electric hammer (Bosch 11304 Magnum) with 1450 blows per minute is used to drive the rod type BM to the point of refusal. The excess rod is cut off nearly flush with the ground and the standard bronze WSC cap is put on and fastened by a 6 mm cross pin. This BM type is primarily used where the site is inaccessible by truck or where rocks are dominant.

The screw BM consists of 19 mm x 3000 mm rod welded to the end of a 38 mm square shaft 300 mm long with a single 1509 mm diameter helical plate 10 mm thick welded to it. A 3500 mm long adapter fits on the square shaft and is driven with the hydraulic crane. The BM is augered into the ground its full length and a standard bronze WSC cap is installed. This BM type is only used in rock free locations which are accessible by vehicle.

Limited vehicle access to some of the gauging stations has prompted the purchase of a portable two-man power auger to drive modified screw bench marks. The modified 2200 mm long bench marks consist of a 19 mm diameter steel rod with a single 150 mm diameter x 6 mm helical plate welded to it.

## B.8 FENCES

Some cattle guard fences are constructed of pressure treated

50 mm x 150 mm x 3700 mm rough planks and 130 mm to 180 mm x 2100 mm treated fence posts. The planks are bolted to the posts with 10 mm x 200 mm U.S.S. cadmium plated bolts. A galvanized metal access gate with swing latch is incorporated into the three plank fence system. Other cattle guard fences consist of 2 NPS metal pipe covered with 3 NPS ABS plastic pipe. A single row of pipe surrounds the shelter except for a small opening in front of the door. The rolling action of the plastic pipe appears to discourage the cattle from rubbing.

## B.9 CONSTRUCTION PERSONNEL

Crew supervision is carried out by a full-time construction supervisor. Only direct on-the-job input from the supervisor is included as a cost item. Indirect cost such as planning, scheduling, logistics, control and administration are not included in the costs contained in this report.

Reconnaissance and pre-construction surveys are carried out by both hydrometric and construction supervisory staff.

## B.10 EQUIPMENT

The construction program is carried out using a combination of in-house resources and equipment and contracts. The crews are self-sufficient in terms of hand tools and common power tools such as generators, cement mixers, drills, saws and pumps. Two vehicles are assigned to the construction section, a 20 000 GVW rated truck complete with gravel box, front end winch and a hydraulic crane mounted behind the cab. This unit is used for placement of prefabricated shelters, driving steel sheet piling, and hauling riprap and construction materials. A three ton van is used for small storage of materials, tools and as a mobile workshop. Trailers are also used to transport shelters and construction materials.

Service contracts or standing offers are utilized to hire local contractors for such work as wiring of shelters, transit-mix concrete, excavation and backfill, hauling construction materials, placement of riprap and aggregate and special services such as construction of access roads.

# APPENDIX C

Photographs

Photo 1 WATHAMAN RIVER BELOW WATHAMAN LAKE - 06DC001

Hauling material for heavy gauge metal boat house to site.

Photo 2 WATHAMAN RIVER BELOW WATHAMAN LAKE - 06DC001

Heavy gauge metal boat house assembled at the site.

Photo 3 MOOSE JAW RIVER NEAR BURDICK - 05JE006

Installing a rock control and wading section

Photo 4 NORTH SASKATCHEWAN RIVER NEAR DEER CREEK - 05EF001

Three wheel bridge crane modified to ensure safer metering operations

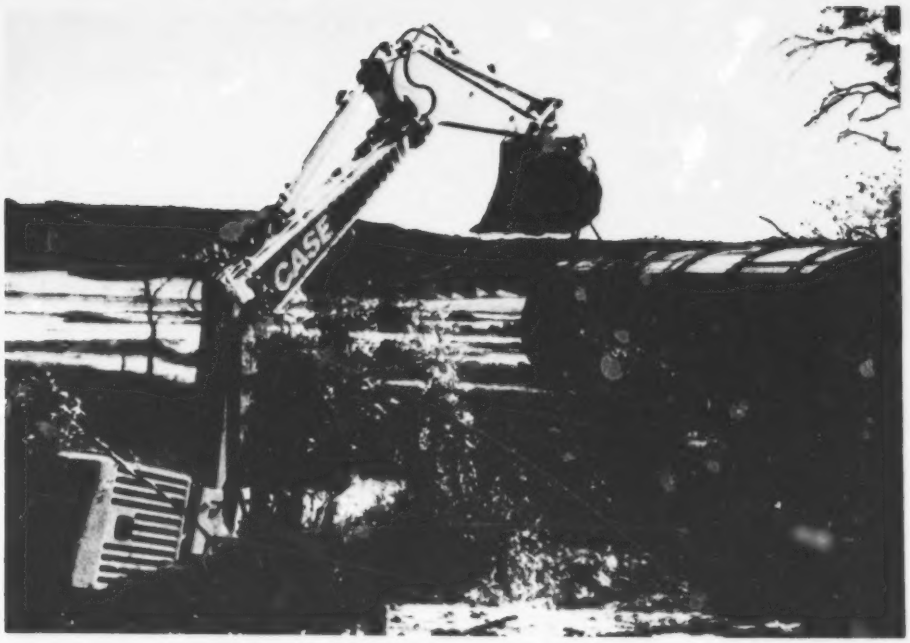



Photo 5 QU'APPELLE RIVER AT HYDE - 05JM013

Installation of stilling well

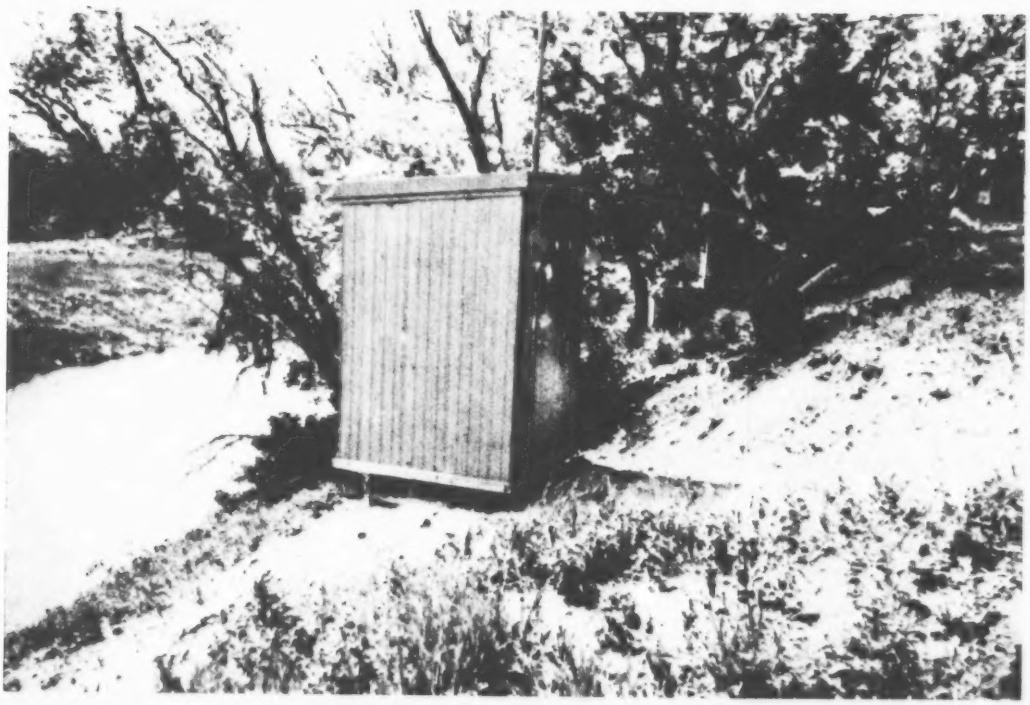
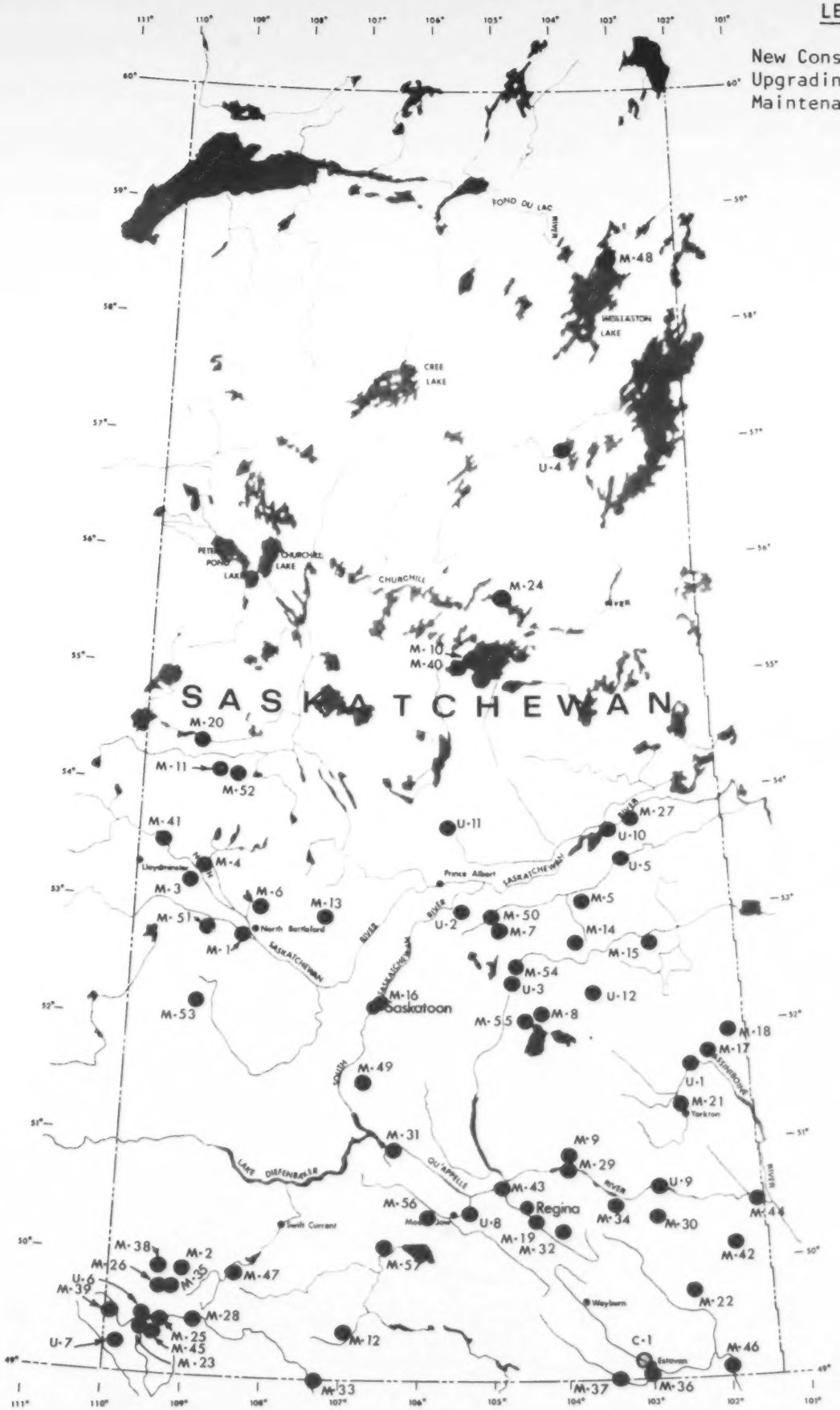


Photo 6 QU'APPELLE RIVER AT HYDE - 05JM013

Station Installation Completed

# APPENDIX D

Location Map


LEGEND
New Construction = C - O
Upgrading = U - ●
Maintenance = M - ●
SASKATCHEWAN
POND DU LAC
RIVER
M-48
MOLSTON LAKE
CREE LAKE
U-4
PETER POND LAKE
CHURCHILL LAKE
CHURCHILL
RIVER
M-24
M-10
M-40
M-20
M-11
M-52
M-41
Lloydminster
M-4
M-3
M-6
M-13
M-51
North Battleford
M-1
SASKATCHEWAN
RIVER
U-11
M-27
U-10
U-5
Prince Albert
SASKATCHEWAN
RIVER
M-5
U-2
M-50
M-7
M-14
M-15
M-54
U-3
U-12
M-53
M-16
Saskatoon
M-55
M-8
M-18
M-17
M-49
SOUTH SASKATCHEWAN RIVER
U-1
M-21
Yorkton
ASSINIBOINE RIVER
M-31
M-9
M-29
LAKE DIEFENBAKER
QU'APPELLE RIVER
M-43
U-9
M-56
Moose Jaw
U-8
Regina
M-34
M-30
M-44
M-19
M-32
Swift Current
M-38
M-2
M-26
M-25
M-47
M-57
M-42
U-6
M-39
M-22
Weyburn
M-28
U-7
M-25
M-45
M-23
M-12
C-1
Estevan
M-46
M-33
M-37
M-36